The Effect of Altering Routine Husbandry Factors on Sleep Duration and Memory Consolidation in the Horse

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Introduction

- Whilst mammals sleep, the brain cycles through different stages of non rapid eye movement (NREM) and rapid eye movement (REM) sleep.[1] Sleep can be characterised by a decrease in motor activity and the presence of recumbent postures (Fig. 1 &2).[2]
- The role sleep plays is not completely understood, however, it is recognised how vital this function is for memory and learning.[3]
- Several studies have demonstrated that the domestic environment of the horse can impact the duration of different sleep states.[4,5]
- The aims of this study were to determine whether altering routine husbandry practices involving lighting and bedding would affect 1. the type/quantity of equine sleep, and 2. memory consolidation.

Figure 1 : A horse displaying lateral REM

Figure 2. Display of sternal NREM

Study Design

Sleep Monitoring

- 10 horses (mixed gender/breed, average age = 14.9 years) were selected at random and split into two groups of 5; continuous focal observations of nocturnal behaviours were achieved with Reolink infrared security cameras.
- A two factor experimental design assessed the effect of straw bedding depth (15cm or 5cm) and overnight light (lights on [lux125] lights off [lux0]) on duration of lateral REM, sternal REM, sternal NREM and standing NREM.
- Each of the four treatment combinations (bedding 15cm-lights on, bedding 5cm-lights off, bedding-15cm lights off and bedding 5cm-light on) lasted for six days and each group received the treatments in reverse order.

Spatial Memory Testing

- Memory consolidation was tested during two of the four treatments (optimal = lights off with 15cm beds and sub-optimal = lights on with 5cm beds) using a spatial memory test.
- Three buckets of the same colour and one bucket of a different colour which contained food (the correct bucket) were randomly moved to different positions (1-4) between trials (Fig.3).
- For both the training (18) and probe (6) trials, horses were randomly released from different starting points (a-e) and the number of correct responses and difference in latency between training and testing phases to locate food placed in the correct bucket were recorded.
- Between the memory tests, a washout exercise was conducted to maximise the treatment effect for the second memory study, during which food was placed in all buckets, with unlimited location time.

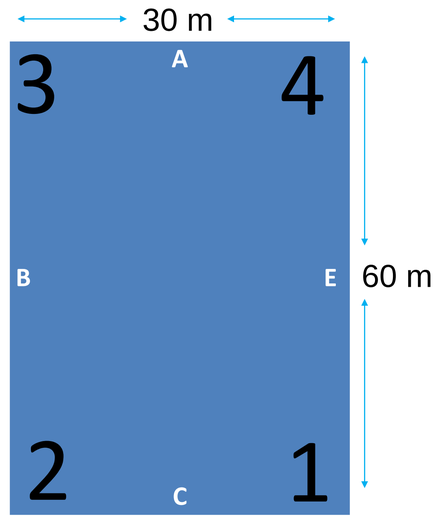

Figure 3:The diagram shows the testing area, labelled with release points and bucket placement points

Results

Sleep Monitoring

- Smaller bed depth (5cm vs. 15cm) significant reduced the duration of sternal NREM (p= 0.007), lateral REM (p= 0.032) standing NREM (p= 0.024) (Fig 4. A,C,D).
- Lights off at night significantly increased duration of sternal REM (p= 0.031) Figure 4 (B).

Spatial Memory Testing

- None of the variables within the spatial memory testing were significantly different between treatments. However, difference in latency approached significance (p=0.07) with lights on-5cm bedding showing the greater difference between the training and testing phases.

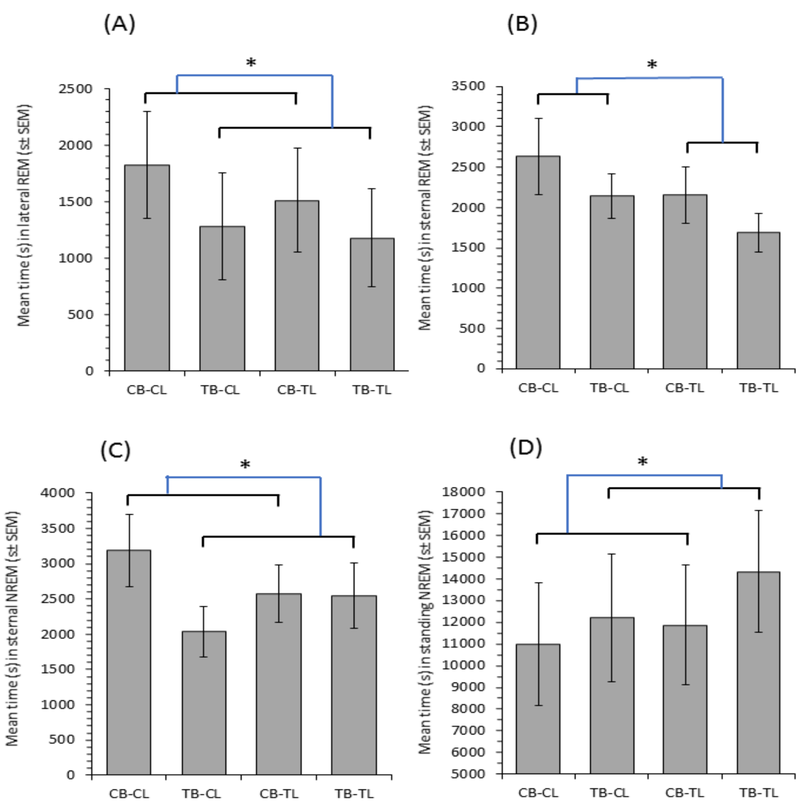

Figure 4: Mean (±SEM) (n=10) time spent expressing the 4 different sleep behaviours, (A) lateral REM, (B) sternal REM, (C) sternal NREM and (D) standing NREM. Treatment: CB-CL (15cm bedding, lights off), TB-CL (5cm bedding, lights off), CB-TL (15cm bedding, lights on) and TB-TL (5cm bedding, lights on). Significant differences between treatments are indicated, *p<0.05

Conclusion

- Both bedding and light significantly affected equine sleep behaviour across all sleep states. These results show that changes to husbandry techniques may have a positive impact on equine welfare via sleep.
- Increasing the sensitivity of the spatial memory test, coupled with a larger sample group may have yielded different results.

References

1. Weber, F. (2017). Modelling the mammalian sleep cycle. *Current opinion in neurobiology*, *46*, 68-75.; 2. Datta, S. (2010). Cellular and chemical neuroscience of mammalian sleep. *Sleep medicine*, *11*(5), 431-440.; 3. Siegel, J. M. (2005). Clues to the functions of mammalian sleep. *Nature*, *437*(7063), 1264-1271. 4. Hartman, N., & Greening, L. M. (2019). A Preliminary Study Investigating the Influence of Auditory Stimulation on the Occurrence of Nocturnal Equine Sleep-Related Behaviour in Stabled Horses. *Journal of equine veterinary science*, *82*, 102782. 5. Raabymagle, P., & Ladewig, J. (2006). Lying behaviour in horses in relation to box size. *Journal of Equine Veterinary Science*, *26*(1), 11-17.